PATENT SPECIFICATION

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DRAWINGS ATTACHED

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(54) IMPROVEMENTS IN OR RELATING TO BEAD COATING

(71) We, EASTMAN KODAK COMPANY, a Company organized under the laws of the State of New Jersey, United States of America, of 343 State Street, Rochester, New York 14650, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a method and apparatus for economically and accurately coating selected areas on a moving surface or plane.

It has been found that, according to the invention, thin coatings with satisfactory uniformity and with a thickness of about 1 mil and higher can be achieved when the plastics coating material is extruded onto a portion of the substrate surface in a longitudinally striped area in a beadlike form whereafter it is spread out to a layer with a predetermined thickness, the width of the layer depending on the amount of applied material.

For coating broad substrates in accordance with the invention, a plurality of spaced beads of coating material are extruded onto the surface.

The reason for this striking result is not entirely known. Probably it is based on the fact that a space is left at both sides of the beadlike deposits into which the coating material can move during the spreading step.

A further reason might reside in the fact that it is easier to control the premature curing of the viscous coating before the spreading step by extruding beadlike formations along longitudinal paths of the surface. This is in contrast to the use of prior art methods and apparatus for laying down a thin layer of viscous material which under the same conditions would cause the coating material prematurely to curve before the spreading and/or smoothing of the layer can be accomplished.

Anyway, it is quite surprising and completely unexpected that a very uniform coating layer can be achieved by starting with quite the opposite measure, namely by applying the coating material in a completely nonuniform (laterally of the area to be coated) manner.

It is an important feature of the present invention that this new method can be very advantageously applied to sheet material mainly for the following reason. When the coating material is deposited, by means of prior art methods, for example curtain coating application and thereafter made uniform for instance by a roller, the excess material will mainly be moved in the direction of the roller movement and it will thus be transported longitudinally with the movement of the roller to the edge of the sheet causing there a curved edge or an irregular rim. Thus all efforts, which are primarily understaken to achieve a clean straight-line cutoff of the coating are afterwards frustrated by the smoothing operation.

On the contrary, our invention provides for the application of a beadlike formation of the extruded material thereby assuring that most of the material to be shifted is moved transversely of the bead direction into the free spaces at both sides of the beads. A longitudinal movement of the material in the direction of the roll movement and within the original bead itself takes place only to a minor extent even if the roller is moved in the bead direction. Thus a real advantage can successfully be made from the use of coating applicators, with improved start and cut-off lines, such as the one disclosed in U.S. Patent No. 3,315,899.

It is especially advantageous to apply a thermo-plastic coating material in heated form and to cure it by cooling below the

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melting point. According to the invention the applied coating material can be maintained in a heated condition until it is spread out. This is especially useful if the thermoplastic materials are polyolefins such as Epolenes (Trade Mark).

Smooth protective or decorative coatings can be prepared from 1 to 3 mils in thickness.

A surface pattern can be embossed onto the coating prior to curing and preferably simultaneously with the distributing step. The substrate to be coated can be a photograph or a printed reproduction. Especially, a lineiform picture can be coated with a lenticulated layer of from 8 to 30 mils thickness.

The device for performing this method consists, according to the invention, of a feeding device, which moves the substrate under a nozzle device for depositing the coating material in bead-like form, the diameter of the nozzle being smaller than the width of the substrate to be coated by the material and a spreading rod or roll being spaced from the path of the substrate for distributing the deposited material to a predetermined thickness. The nozzle head preferably has a plurality of spaced individual nozzle openings. Advantageously, a heated cylinder is provided for moving the substrate having deposited thereon the beadlike material from the nozzle device to the spreading rod or roll.

It is an important advantage of this device, that it can be attached to a typical printing press without difficulty.

These and further objectives and advantages of the present invention will become more apparent upon reference to the following description, claims, and appended drawings wherein:

Figure 1 is a simplified flow diagram outlining the various method steps of the invention;

Figure 2 is a schematic diagram of a preferred embodiment of the apparatus intended to carry out the method of the invention;

Figure 3 is a schematic diagram of another embodiment of the apparatus which may be used to carry out the method of the invention and in which the substrate material has a substantially straight line flow-path;

Figure 4 is a schematic diagram of a representative control system which may be used with and incorporated in the apparatus of the invention;

Figure 5 is a perspective view of one of the valve and nozzle arrangements used in the coating apparatus;

Figure 6 is a cross-section taken along lines VI—VI of Figure 5 and

Figure 7 is a bottom view of the valve and nozzle arrangements shown in Figure 5.

With continued reference to the accompanying figures wherein like reference numerals designate similar parts throughout the various views, and with initial attention directed to Figure 1 which illustrates the general method of the invention, it can be seen that the use of substrate materials, which may be printed or unprinted and in either sheet or roll form is contemplated.

The method further contemplates the possibility of intermediate storage prior to the coating operation and therefore it may be necessary to feed to the coating zone from a stacked formation of the substrate. The multiple capabilities of this system thus prevents a versatile overall method of coating in addition to achieving the prime objective of the invention; that being the development of a satisfactory thin layer coating method which is either adaptable to existing equipment or easily manufactured as an integral self-contained unit and which can also be used for spot coating.

From the storage area or, in an in-line operation, from a preceeding stage, the substrate material used in practicing this invention is fed to a coating zone in which the presence of the material of the area thereon to be coated is sensed and the depositing system is activated. After deposition, the inherently beaded formation is evently spread so that the entire area to be coated is uniformly covered. Immediately thereafter, or in conjunction therewith, the coated area may be deformed in any pattern desired after which the coated substrate is forwarded to another stacking mechanism. Of course, should it be so desired, the substrate may be rerolled or forwarded to subsequent treatment areas such as, for example, cutting and slitting stations where the coated stock may be trimmed to size.

It is unnecessary in the practice of the invention that a completely integral single line system be used. A partial system where the substrate is transferred from stack to stack with intermediate coating may at times be desirable or necessary. In such cases the feeding mechanism will remove a particular sheet, or the roll material, from its respective stack or roll, pass it through the coating area to the smoothing and deforming station, and it will subsequently be recollected in its original form, assuming no further treatment is desired.

Any number of suitable substrate materials such as paper, ceramics, cloth, wood or metals may be used in practicing this invention. However, for illustrative purposes, particular emphasis will be placed hereinafter upon the use of paper substrates.

As will be apparent to those skilled in the art, the invention can be used in decora-

tive and/or functional applications. Functional uses include, for example, lenticulated surfaces, contoured surfaces, braille systems, and computer tapes and cards, any or all of which may require deformation during their formation. Of course, in protective applications it is only necessary thinly, evenly, and smoothly to coat the substrate material. The coating material can be colored.

In a preferred embodiment of the apparatus in accordance with the invention, a plastics material melt storage and pumping system 10 is attached to a modified printing press generally designated as 12. Within this press is located a sheet stacker 14 containing paper or other substrate sheet materials 1 which may be grasped by a suction device 16 and transferred to the belt and roll feed systems 18. As a sheet 1 is forwarded through the roll system 18, its presence is sensed by a sensing means 20 such as a flag switch or photo-electric cell which thereupon emits a signal to activate a timing or other delay mechanism 22. The timer 22, of course, may be pre-set according to the speed of travel of the substrate material, the position where the deposit is desired, and the size or length of the deposit desired. These variables being controlled therein, the timing mechanism 22 will subsequently signal a solenoid 27 which upon its activation will allow air or some other suitable activating medium from a pressure source 21 to enter nozzle applicator 26. This will open the valve of this applicator and effect a properly placed deposit of the coating material, from system 10, upon the substrate, which continues to be advanced and is grasped by grippers contained upon a compression cylinder 24 and is thus transferred beneath the coating nozzle applicator 26. The coating nozzle applicator will be more fully described hereinafter. It deposits the viscous coating material in a bead form upon the sheet 1 or upon any particular portion thereof.

After the deposition, a rod or roller 28 functions to smooth the beaded material deposit preparatory to a transfer of sheet 1, to a compression cylinder 30. Cylinder 30 has a deforming surface 32 acting in conjunction with the cylinder 24 to deform the coating into the particular configuration desired. A steam or water spray system 34, including a supply source 35, is directed upon the cylinder 30 in order to provide for the easy release and transfer of the plastic-coated substrate therefrom and to a take-off cylinder 36. From the cylinder 36 it can be seen that the sheet 1 will be grasped by a roller-chain delivery system 38 and subsequently deposited upon a stacking mechanism 40. Both of the stackers 14 and 40 can be seen as being movable in the vertical direction by any suitable powered means, so that sheets may be adequately removed or deposited without difficulty.

It should be recognized that the aforedescribed timing device and sensing mechanism may be replaced by any suitable computerized system which may be made integral therewith. Where a computor 42, as shown in Figure 3, is programmed to the over-all coating system, sheet or web feed, as well as fluid material deposition may be controlled by the computor itself. Template 44, card 46, tape 48 or other similar computor input means may be employed therewith.

One possible modification of the preferred embodiment contemplates the use of roll-stock material which can be fed into and through the coating system. This, of course, would be particularly adaptable to a system as shown in Figure 3 wherein there is shown a generally straight-through flow pattern of the substrate within the apparatus as it is being coated. Again it should be noted that a feeding mechanism 18, in this case feed rolls, advance the material through a sensing area where sensor 20 detects the substrate presence and activates a fluid control delay device 22. This control delay device in turn energizes the solenoid 27 thus allowing for the deposit of the coating material supplied under pressure from the storage and feed system 10. After deposition intermediate feed rolls 52 advance the stock between the smoothing rolls 50 and onward to the deforming rolls 24, 30.

In a manner similar to that previously described, stacked sheets may be fed through the system of Figure 3. For example, a stacker 14 or a direct feed from a printing press 54 can be used to supply the sheets, either of which may replace the roll stock supply 13. In most cases it is conceived that printed materials of various forms will be coated by this method and apparatus. One specific item of particular interest are lineiform pictures which when covered by a lenticulated plastic coating give a three-dimensional effect. These pictures would first be printed, then coated, and the coating surface deformed as hereinbefore mentioned.

Several coating nozzle applicators 26 may be arranged in tandem, as is shown in phantom in Figure 3 for two such applicators, along the path of movement of the substrate if a composite coating or layering type effect is necessary or desirable. By employing a second supply system 10 and related conduit system, the second or added tandem nozzles, with or without intervening smoothing means, could be supplied with a different coating material thus giving the added capability of placing different

materials in a laminate array or in alternate positions upon the substrate.

Referring again to Figure 2, it can be seen that the viscous fluid feed and storage may consist of an extruder 8 or other suitable feed means capable of depositing the fluid material to be used as the coating, into a storage tank 6. From this holding reservoir, pump 5 transfers the viscous fluid through a piping or conduit system 4 to the valve 26. Due to the viscosity of the materials generally being handled, such a system must be under a relatively high positive pressure, for example, of the order of 200 psig.

The coating nozzle applicator will now be described referring now to Figures 5, 6 and 7. This device resembles the adhesive applicator described in the U.S. Patent No. 3,315,899. However, it has been modified with respect to the nozzle outlet construction.

While using only a single applicator 26, a plurality of nozzle openings 19 can be supplied from the head 25 which has a fluent reservoir 33 therein. The nozzle openings 19 are preferably spaced approximately 0.10" apart, but, of course, such spacing depends upon the orifice size, fluid viscosity, and pressure.

It will be obvious from the drawings that in order to get increased lateral coverage it is only necessary to abut the ends of the heads 25 in any suitable mounting upon the coater. These head lengths can range in length from, for example, 4" to 12", but with increased fluid pressure, the length may be as much as 107" or more. As will be appreciated these valve and manifold heads 25 are closely adjacent the substrate path and preferably are between 0.002" and 0.250" above the substrate surface.

In Figure 6 it can be seen that the fluent coating material enters the applicator 26 at opening 35 and depending upon the position of valve stem 15 may be conducted via passages 17 to the reservoir 33 and nozzles 19. Valve stem 15 is activated by the introduction of a hydraulic or some other fluid medium through openings 29 and 31 which are at opposite ends of the cylinder 9. Piston 13 is connected to valve stem 15 and is free to ride within cylinder 9 between its upper and lower ends which are defined by cap 27 and valve body 23.

When piston 13 is in an intermediate or lower position, as is shown in Figure 6, the pressurized fluid is allowed to enter at opening 35 and be deposited through nozzles 19 as above-discussed. However, as the piston 13 and valve stem 15 move upward the headed portion 50 of the valve stem enters the cylindrical area 52 of body 23 and shuts off the fluid flow. The upward movement of the piston 13 is thereafter continued and because of this, a partial vacuum is created in reservoir 33 and nozzle 19, thus withdrawing the tailings outside of the nozzle area into the reservoir thereby effecting a clean cut-off. The created vacuum depends on the size of the headed portion 50 which may just fill the cylindrical area 52. A more complete discussion of similar valve actions and constructions can be found in the above-mentioned patent.

The fluid handling portion of the apparatus, in the case of highly viscous plastic materials, must be maintained in a heated condition to preserve the viscosity of the particular fluids being used, and, of course, the degree of heat will also be dependent upon these materials.

The method and apparatus according to the invention work especially well with blends of polyethylene and/or polypropylene which are disclosed in our copending Patent Application No. 48992/65 (Serial No. 1,133,224) and which are commercially available under the Trademark Epolene 103.

WHAT WE CLAIM IS:—

1. A method of coating substrate material surfaces, for example, of paper, by extruding a predetermined amount of a plastics coating material onto the surface characterized in that the coating material is applied onto a portion of the surface in a longitudinally striped area in a beadlike form and thereafter spread out to form a layer, with a pre-determined thickness, the width of the layer depending on the amount of applied material.

2. A method according to Claim 1 characterized in that a plurality of spaced beads of coating material are extruded onto the surface.

3. A method according to Claim 1 or 2 characterized in that the substrate is sheet material.

4. A method according to Claim 1, 2, or 3 characterized in that the coating is cured after the spreading step.

5. A method according to Claim 1, 2, 3 or 4 characterized in that a therrmoplastic coating material is applied in heated form and cured by cooling below the melting point.

6. A method according to any preceding Claim characterized in that the applied material is maintained in a heated condition until after it has been spread out.

7. A method according to any preceding Claim characterized in that the thermoplastic material is a polyolefin.

8. A method according to any preceding Claim characterized in that a smooth protective or decorative coating from 1 to 3 mils in thickness, is prepared.

9. A method according to any of Claims 1 to 7 characterized in that, simultaneously with or subsequent to the formation of the uniform layer, a surface pattern is embossed onto the coating prior to curing.

10. A method according to any of Claims 1 to 9 characterized in that the substrate to be coated is a photograph or printed reproduction.

11. A method according to Claims 9 and 10 characterized in that a lineiform picture is coated and provided with a lenticulated surface pattern.

12. A method as claimed in Claim 11 wherein the patterned layer is from 8 to 30 mils in thickness.

13. An apparatus, for performing the method according to any of Claims 1 to 12, with a feeding device for moving a substrate to be coated, a nozzle device for depositing a plastics coating material in beadlike form characterized in that the diameter of the nozzle is smaller than the width of the substrate to be coated, a spreading rod or roll being spaced from the path of the substrate for spreading the deposited material to a predetermined thickness.

14. An apparatus according to Claim 13 characterized in that the nozzle device has a head with a plurality of spaced individual nozzle openings.

15. An apparatus according to Claim 13 or 14 characterized by a heated cylinder for moving the substrate having deposited thereon the beadlike material, from the nozzle device to the spreading rod or roll.

16. A method of coating substrate material surface as claimed in Claim 1 and substantially as hereinbefore described.

17. An apparatus for carrying out the method as claimed in Claim 16 and substantially as hereinbefore described with reference to and as illustrated in Figures 1, 2, 5, 6 and 7 or Figures 1, 3, 5, 6 and 7 or as illustrated therein and as modified by Figure 4.

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1235704 COMPLETE SPECIFICATION
4 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

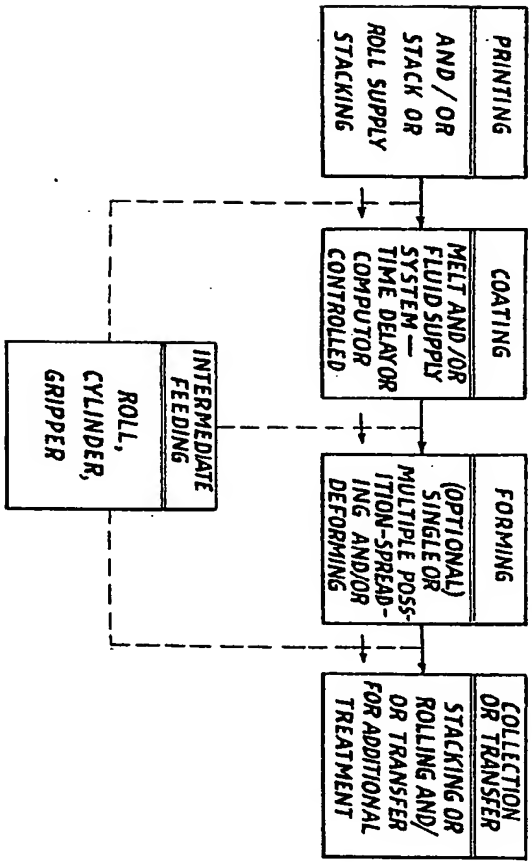

FIG. 1.

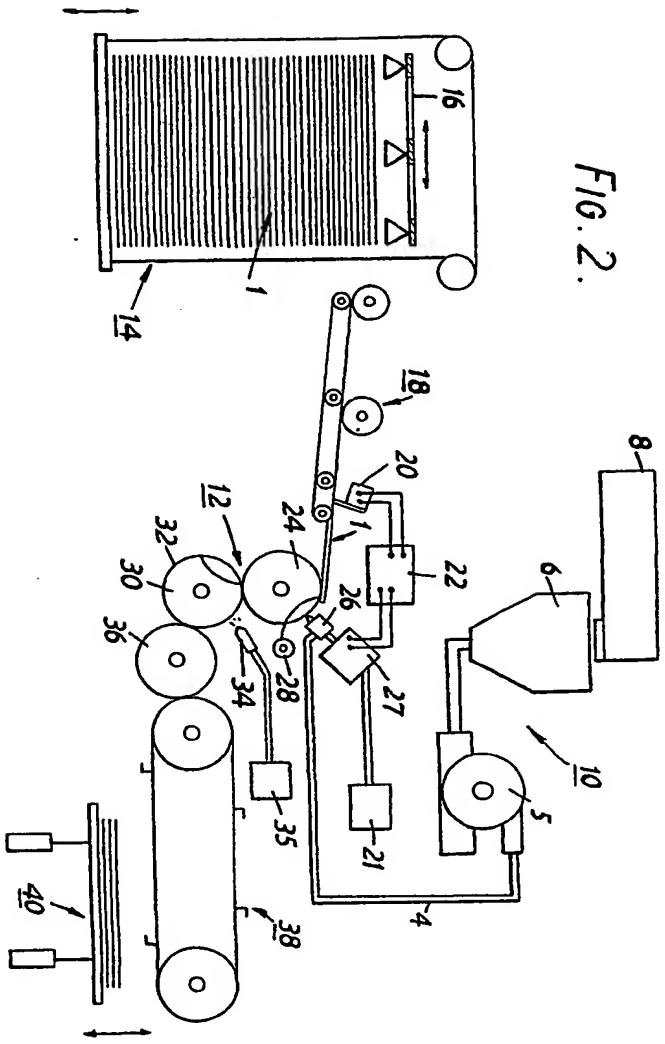

FIG. 2.

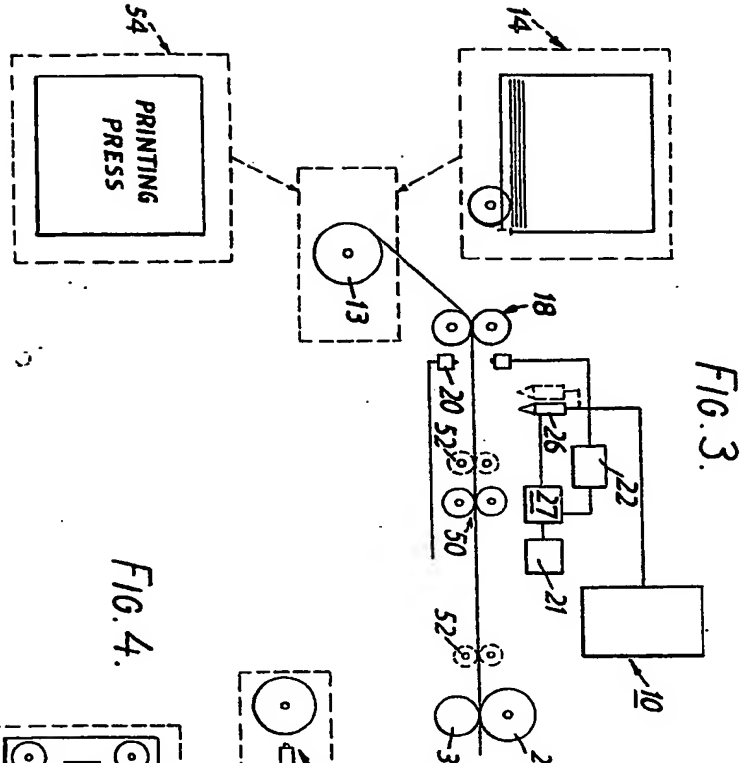
54
PRINTING PRESS
14
13
18
20
52
26
22
27
50
21
52
10
30
24

FIG. 3.

FIG. 4.

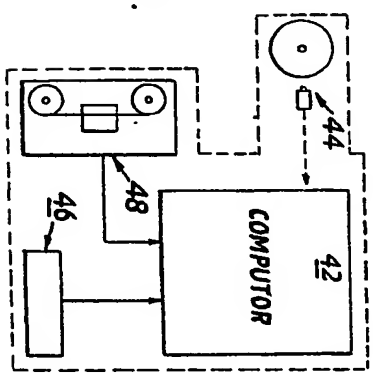
44
48
46
COMPUTOR
42

FIG. 5.

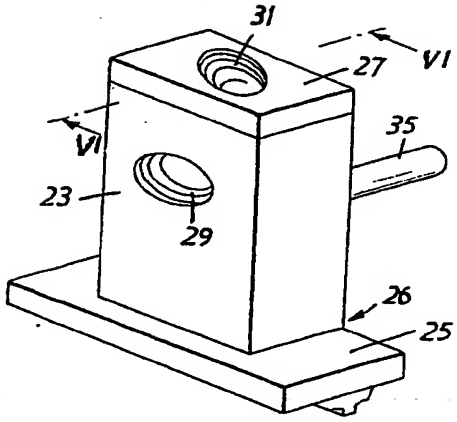

FIG. 6

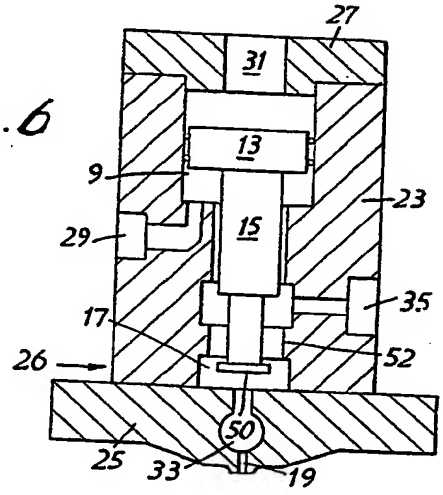

FIG. 7.